# Governing sustainability transitions: contrasting experimental arenas through the lens of Agenda 2030

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# Abstract

In 2015, the necessity of fundamental societal change was outlined in a universal, transnational agreement with the headline of "transforming our world". The UN 2030 Agenda for Sustainable Development includes 17 Sustainable Development Goals, ranging from ending poverty and establishing gender equality to halting climate change and sustainable cities and communities. Building on UN and scholarly debates, we put forward two key principles to guide the realization of Agenda 2030: *transformation* (to sustainability) and *integration*. T*ransformation* refers to the understanding that fundamental change is necessary to achieve sustainability; *Integration* recognizes that such change is dependent upon different perspectives, such as sustainability dimensions and the SDGs themselves, and different actors. At the same time, laboratories in real world contexts have emerged from various discourses, and are portrayed as settings to host potentially transformative experimentation and innovation processes and integrate various perspectives and actors. Sustainability related labs contribute a significant share to all labs existing. Despite their proliferation across the local, regional and national levels, it remains unclear how different laboratory settings might relate to processes of integration and transformation. Labs have seldom been attached explicitly to Agenda 2030 in practice, and a systematic assessment of the suitability of labs to support agenda 2030 so far is lacking. Hence, the main aim of this work-in-progress paper is to situate existing lab approaches from real world contexts in relation to the ambitions of Agenda 2030. It is guided by the following main research question: *What is the capacity of labs in real world contexts in contributing to agenda 2030 by processes of transformation and integration?* The paper presents the progress of an ongoing study, which intends to employ a step-based systematic review approach. Firstly, we highlight and unpack the key principles to guide the realization of Agenda 2030: *transformation* (to sustainability) and *integration*, and propose an analytical framework related to these principles. Secondly, and currently ongoing, we investigate a breadth of lab approaches building on a systematic review to draw out their capacities to contribute to transformation and integration. Results of the first stage are presented, before the paper ends by outlining the ongoing data collection process, describes the sample and provides a brief outlook.

# 1 Introduction

In 2015, the necessity of fundamental societal change was outlined in the form of a universal, transnational agreement under the headline of “transforming our world”. The agreed upon UN 2030 Agenda for Sustainable Development includes 17 Sustainable Development Goals (SDGs) (United Nations, 2015), ranging from ending poverty and establishing gender equality to halting climate change and sustainable cities and communities. When combined, the goals and related Agenda 2030 present a comprehensive roadmap to overcome the persistent challenges faced by modern society and realize sustainable development.

In this paper, and building on respective policy and research discourses, we highlight two key principles to guide the realization of Agenda 2030, namely *transformation* (to sustainability) and *integration*. Used as keywords in respective debates, these principles highlight the quality and direction of desired change processes. Transformation broadly refers to processes or practices that might result in fundamental changes in properties of a system (Fazey et al. 2018, Patterson et al. 2017). Reconfiguration is advocated as the means to allow for structural and widespread alterations capable of overcoming system lock-in and path dependency. The title “transforming our world” might therefore refer to both the de facto fundamental alteration of natural and social systems caused by ongoing human action (the ´Anthropocene´), and upcoming societal developments. Fundamental change will occur in any case, either as forced response to the consequences of a warming planet or as a deliberately designed shift towards new forms of human-human and human-nature interactions. Agenda 2030 speaks of a fundamental transformation of “our world to the better” as a essential to fulfilling all SDGs (UN Agenda 2030 Preamble). Such change, is argued, cannot occur in isolation. Rather, it must be underpinned by integration as a multi-faceted approach that encompasses multiple actors, sectors and levels. As encompassing global goals, the SDGs are regarded as interrelated and indivisible, as well as connected to different dimensions of sustainability (UN Agenda 2030 Preamble & declaration point 13). Agenda 2030 appeals to all nations and all stakeholders to mobilize in new and far-reaching collaborative partnerships (ibid). Realization of Agenda 2030 thereby rests on the ethical imperative of universality, meaning that sustainable development should benefit everybody, leaving no body behind, thus contributing towards inter- and intragenerational justice (UN Agenda 2030 Preamble).

Deliberately steering societal change towards a desired future is an endeavor of tremendous size and complexity. It requires one to not only understand the present state, but as well to agree upon desirable future states and find ways to move towards them. Contemporary literature argues that, when approaching societal challenges, it is necessary to approach conditions of uncertainty, ambiguity and non-linearity (e.g. Rotmans and Loorbach 2009, Schot and Geels 2008). Learning, reflexivity and experimentation have been proposed as coping strategies to deal with such conditions. Furthermore, deep engagement with a variety of societal actors can contribute to realizing Agenda 2030, by building on transformation and integration when including governments at different levels, as well as the economy, civil society, and research. This joint effort can be termed ´governance´, and developing governance approaches aiming to support the realization of Agenda 2030 by following both key principles of

transformation and integration may be deemed as worthwhile. Such a principles-based approach can be argued to complement more traditional goal-oriented policy and practice (Patton, 2017). Principles-based engagement places stronger emphasis on experimentation, learning and reflexivity – important cornerstones when entering uncertain terrains, not least argued for by transition scholars (Rotmans et al., 2001; Smith et al., 2005; Voss, Bauknecht & Kemp, 2006; Loorbach, 2007).

Laboratories situated in real world contexts have emerged in discourses related to transformations and transitions as promising governance approaches to engage with complex sustainability related challenges (e.g. Schäpke et al. 2018a, Nevens et al. 2013). These labs constitute bounded settings for experimentation and testing of innovative solutions to sustainability challenges in collaboration of various actors (Evans, Karvonen & Raven, 2016, Bulkeley and Castan Broto 2013). As safe spaces they allow to experiment, test and learn across contexts and under conditions of uncertainty and complexity. Experimental practices in labs are unfolding within and across contexts, giving rise to an ever-broadening array of conceptualizations, characteristics and outcomes. Variants such as living labs and innovation labs are often situated within socio-economic transitions research; urban transition labs, real-world labs and challenge labs are frequently framed in socio-technical transitions literature; and transformation labs consider the transformation of socio-ecological systems (e.g. Schäpke et al. 2018a, b, Larsson and Holmberg 2017, Sengers et at. 2017, Voytenko et al. 2017).

**Research Gap**

Despite the proliferation of labs at the local, regional and national level, it remains unclear how different laboratory settings might relate to processes of integration and transformation. There are examples of labs contributing to sustainability-related local administrative processes (e.g. Nevens et al. 2013), as well as those that draw experience from Agenda 21 processes as predecessors of agenda 2030 (e.g. Wittmayer et al. 2016). Until this point however, society-based laboratories have seldom been attached explicitly to Agenda 2030 (with some exceptions on the level of policies, e.g. https://www.sdglab.ch/about/, http://sdglabmadrid.es/?lang=en and https://seedbeds.futureearth.org/sdg-labs/. In addition, a systematic assessment of the suitability of labs to support agenda 2030 so far is lacking. How do labs relate to the normative aim of transformations to achieve agenda 2030? Are labs suitable to host processes of transformation or do lab activities and results generated by them actually precede later transformations? Are labs themselves forming via the integration of actors and their aims, or do they primarily host these processes? In recognition of both the need to develop synergies when approaching complex sustainability challenges and the urgency associated with Agenda 2030 on a global level, we argue for the importance and timeliness of connecting labs to the principles of transformation and integration.

**Research aim**

The main aim of this paper is to situate existing lab approaches from real world contexts in relation to the ambitions of Agenda 2030. This is done against the backdrop of salient sustainability transitions, socio-ecological transformations and socio-economic transitions research.

**Research questions**

We follow this aim by addressing the following main research question and related sub-research questions: ***What is the capacity of labs in real world contexts in contributing to agenda 2030 by processes of transformation and integration?***

*Sub-questions:*

1. How can we understand transformation and integration in their contribution to realizing agenda 2030/ the SDGs?
2. How do labs in real world contexts relate to transformation and integration supporting the realization of agenda 2030?.
3. How could transformation and integration be captured in a framework to analyze labs in real-world contexts?
4. How do different lab settings contribute to realizing transformation and integration, for instance by which kind of features, processes and methods (Future research) ?

In contribution to the research questions proposed above, the remainder of this paper is structured as follows. Firstly, and related to sub question 1, we highlight and delineate concepts of transformation and integration, as principles to guide governance approaches towards the realization of agenda 2030 (section 2.1). Secondly, we then expand upon labs as promising real-world settings to host governance attempts oriented towards agenda 2030 (Sub question 2, section 2.2). Thirdly, we propose a broad analytical framework, capable of discerning elements of transformation and integration in current lab settings (Sub question 3, section 3). Following this, we outline our planned research methodology (section 4).

As this paper represents an ongoing research process to be conducted in the duration of 2018, it is currently not possible to draw meaningful conclusions regarding labs at this point. Rather, we will conclude with a brief summary of our collected data (section 4) and contribute with a preliminary discussion and research outlook towards addressing research question 4.

# 2 Conceptual delineation

Agenda 2030 presents an ambition to "transform our world", guided by 17 Sustainable Development Goals that are *"integrated and indivisible and balance the three dimensions of sustainable development: the economic, the social and environmental"* (United Nations, 2015). In this section we elaborate on two principles highlighted for the global realisation of the SDGs and Agenda 2030: *transformation* and *integration.* In doing so, we provide an overview of pertinent research fields addressing transformation and integration in relation to sustainability and discern core aspects shared in the different fields. Consecutively, we elaborate on important aspects of labs in real world settings in relation to transformation and integration following normative aims, such as agenda 2030.

## 2.1 Principles: Transformation and Integration

### *2.1.1 Transformation*

*Transformation* refers to the understanding that fundamental change is necessary to achieve sustainability (e.g. EEA 2018). A number of recently published reviews provide an overview of research fields addressing transformations (e.g. EEA 2018, Loorbach et al. 2017, Feola 2015, Schneidewind and Augenstein, 2016). Basic perspectives jointly outlined by these studies[1] include work describing and explaining radical changes in socio-ecological (Gunderson & Holling 2002, Folke et al. 2005, Haberl et al. 2011) and socio-technical (van den Berg et al. 2011, Geels and Schot 2007, Markard et al. 2012) systems.

A number of key aspects are put forward by the different perspectives. Loorbach et al. (2017) proposes the nonlinearity of developments, multiple levels of interaction including regimes and niches, and the co-evolution of developments contributing to emergence of changes and new qualities of the system. Thus, aspects are based on a systemic perspective of transformation. Accordingly, transformation is either about fundamental alterations of socio-ecological systems at large scale, discussed for instance in terms of planetary boundaries, and tipping points. Or it is understood as "'a process of altering the fundamental attributes of a system, including structures and institutions, infrastructures, regulatory systems and financial regimes, as well as attitudes and practices, lifestyles, policies and power relations' with the aim of tackling sustainability challenges" (EEA 2018: 9).

In addition, conceptualizations of transformation typically entail qualitative structural change of systems, with interacting human, biophysical and/or technological components (Feola, 2015). This includes for

[1] Various typologies of perspectives on transitions exist: Loorbach et al. 2017 distinguish three basic perspectives on sustainability transitions, including socio-technical, socio-ecological and socio-institutional while EEA 2017 distinguishes three basic and two complementary perspectives (Socio-technical, socio-ecological, socio-economic as well as action oriented and integrated assessment approaches). Schneidewind and Augenstein (2016) distinguish idealist, institutional and technologically focuses schools in studying transformation while Patterson et al. 2016 name socio-technical, socio-ecological systems, pathways and transformative adaptation as approaches of transformation governance. Feola finally distinguishes eight concepts of transformations including societal transitions and socio-ecological transformations (2015). Socio-technical and socio-ecological are the most commonly share perspectives and we assume them sufficiently for the purpose of this review.

instance radical changes in the personal sphere including beliefs, values, worldviews and paradigms (e.g. Sharma, 2007; O'Brien & Sygna, 2013; Göpel, 2016). Transformations in social practices and ways of living (Shove 2010), and more macro-scale studies i.e. on the nature of capitalism (EEA 2018, Göpel 2016). In an attempt to summarize - processes of transformation are characterized by complexity, uncertainty and ambiguity; where systems shift from one dynamic equilibria to another, resulting in a radically different architecture from what was before.

By using the direction of desired changes as a starting point, it is possible to substantiate the principle of transformation as one oriented towards sustainability. When recalling the importance of sustainability in the agenda 2030 as the context of this study, it is implied that transformations do not simply contribute to an instrumental approach towards 'achieving' different SDGs; instead, they do so in a universal fashion, underpinned intra- and intergenerational justice.

The issue of sustainability is partly represented in sustainability transitions and transformations research as outlined by recent reviews. Accordingly, Feola (2015) points out that most authors consider fundamental change as a key outcome of transformation, but only some elaborate on this when such change can actually be considered sustainable. In socio-technical transitions research, perspectives prevail that describe the aim of transitions in contribution to solving persistent societal problems. How and against which normative yardstick to assess whether problems are solved, and for whom, is seldom elaborated (Schäpke in print, Rauschmayer et al, 2015[2]). Authors do often explicitly relate their work to generally agreed normative goals, such as the SDGs. However, they dedicate the process of contextualizing, addressing and assessing sustainability transformation to particular transdisciplinary and democratic decision-making processes (ibid., cp Feola 2015). As an example, transition management emphasizes shared ideas and visions about sustainability to guide the process (Loorbach et al. 2011, Frantzeskaki et al. 2012). In this approach, the process of transformation links societal problem-solving with an orientation towards jointly agreed upon desirable futures.

There are efforts to combine and assess aspects of global environmental change with justice and equity (EEA 2018). In the field of socio-ecological transformations research, several authors propose transformations to contribute to increasing resilience, adaptive capacity of systems and maintaining planetary boundaries (e.g., Park et al. 2012, Rockström et al. 2009). Alternatively, others are more oriented towards maintaining social conditions such as equity and justice (Patterson et al. 2017) and increasing empowerment and agency (O'Brien, 2012). There are also studies which argue for a combination of both, benefiting both society and ecosystems (Marshall et al. 2012). The sustainability pathways concept (Leach et al. 2007; 2010; 2012) does suggest an interesting combination, voicing transformation being about navigating pathways between the foundation of social boundaries and the ceiling of planetary boundaries (Patterson et al. 2017: 7, citing Leach et al. 2012, 2013).

In summary, the continuation of this paper focuses on two broad analytical groups for adequately covering aspects of transformation. These include 1) an underlying *systemic perspective* on

[2] Accordingly, Loorbach et al. do not elaborate on sustainability further when reviewing the field of sustainability transitions.

transformation including the *quality of change* and 2) *sustainability* as the aim and direction of transformation.

### *2.1.2 Integration*

*Integration* refers to the recognition that Agenda 2030 is based on an integrated understanding of sustainability that interlinks economic, ecological and social dimensions, and that the SDGs are interrelated and indivisible (UN Agenda 2030 preamble). Similar to transformation, integration in relation to sustainability is referred to in the literature in various ways. One area refers to the interrelations between different dimensions and SDGs, and possibilities to approach them in an integrated way (Stafford-Smith et al. 2017). SDGs should be comprehensively implemented to prevent trade-offs, pervert developments and neglected interdependencies when aiming to achieve single SDGs. Accordingly, Stafford-Smith et al (2017) stress the importance of sectoral integration of for instance finance, agriculture, transport and energy. Le Blanc (2015) highlight the topic of policy integration, which approaching SDGs in an integrated manner.

Contributions to understanding interactions between dimensions, goals or sectors do often originate within discrete scientific disciplines, but in a similar fashion are increasingly engaging with broad societal actors. Issues surrounding integration in this way have been conceptualized within 'post-normal' science (Funtowicz & Ravetz, 1993) concerned with handling high decision stakes and inherent system uncertainties, in "mode-2" knowledge production (Gibbons et al., 1994) that is context-driven, problem-focused and interdisciplinary, and in transdisciplinary research (Klein, 2004; Hirsch-Hadorn et al., 2008; Lang et al., 2012) and transformative science (WBGU 2011, Schneidewind et al. 2016). Knowledge from different perspectives is often associated with different actors, and social collaboration is encouraged among diverse sets of actors (including those with marginalized perspectives). This enables a broad representation across the 'whole societal or socio-ecological system' in question. Dialogue, awareness, trust-building and openness are often emphasized as central tenets in order to integrate perspectives and approach complex challenges together (Wendelheim, 1997; Bohm, 2013; Sandow & Allen, 2005; Jordan, 2011)

Relatedly, Agenda 2030 explicitly emphasizes the collaboration of multiple actors for fundamental and desirable change. When faced with wicked problems that are characterized by contingency and societal disagreement, new *"cooperation between different scientific domains and society at large"* are required to venture into uncertain terrain (Brandt et al., 2013, p.1). Hence, meaningfully engaging with stakeholders such as government institutions, research centers, citizens, civil society organizations and private actors is a fundamental component in the normative framework of Agenda 2030. Accordingly, Stafford-Smith et al (2017) stress the importance of actor-wise and international integration. It is likely that such efforts will aspire to *"mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries"* (UN, 2015, pg. 28/35).

Given the emphasis on mobilization and partnership-building, recent science-society agendas are shifting their attention to cultivating methodologies that are capable of integrating such actors around complex sustainability topics. Systemically-oriented approaches, integrated assessments, or those concerned with developing scenarios and constructing visions of the future all represent notable attempts to integrate plural perspectives in search of socially-robust knowledge (Ness et al. 2007; Jerneck et al, 2011). Integrative methods more often than not rely on deep forms of engagement across diverse stakeholders, concerning divisive environmental and societal challenges that might have been governed in conventional manners previously.

Literature suggests that attempts for integration of actors should be considered as more than merely instrumental (Reed, 2008). They require trust-building and social learning processes to developed within and across sectors, disciplines and groups. However, it is not necessarily the case that participation and collaboration alone will result in change. For example, the outcome of deliberative scenarios might lean more towards incrementalism (Feola, 2015). Moreover, integrative methods embedded in institutional and economic frames that reflect dominant narratives and as well as political landscapes that favour short-termism may hinder progress towards transformative change. Likewise, conventional decision-making configurations represent unsuitable spaces for perspective and actor exchanges capable of system-wide transformations. Aspects such as hierarchies, power relations and exercising of control are important to consider when understanding possibilities, limits and effects of actor integration. Folke et al argue that "policy should create arenas for flexible collaboration and management of social-ecological systems, with open institutions that allow for learning and build adaptive capacity" (2002, p.439).

In summary, the continuation of this paper focuses on two broad groups for adequately covering aspects of integration. These include 1) *Integration of perspectives* (such as the sustainability dimensions) and 2) *integration of actors*.

One recent phenomena of interest in this context are laboratory approaches in real world contexts, particularly as novel modes of governance in different socio-political settings. In a relatively short space of time, they have emerged from various discourses, often crossing different disciplinary and normative settings. As a result, we see an opportunity in analytically connecting principles of transformation and integration as a way to investigate a breadth of lab approaches. Before doing so, section 2.2 will first synthesize the current understanding of lab approaches.

## 2.2 Laboratories in the real world

Running in parallel to Agenda 2030, conceptual and applied appeal of labs in real world contexts for sustainability is growing globally (see figure 2 below). Although framed in a variety of ways, one broad premise of these labs is that of a space providing qualities relevant for processes of change to occur. Such processes might materialize from different origins (i.e. from product/service development, catalysis of learning and experimentation to facilitation of organizational development. They may develop using different methods or tools (i.e. backcasting, visioning, participatory design) (Schäpke et al. 2018b). Despite this heterogeneity, learning-by-doing based on experimentation involving diverse actors are features

commonly associated with labs (Sengers et al. 2016). Thus, settings such as living labs, urban living labs, real-world labs, change labs and challenge labs represent a relatively young and rapidly growing mode of collaboration between academia, industry, civil society and governments (Schäpke et al. 2018a).

Many of the current applications of labs have been developed in core fields contributing to an understanding of transformation and integration. They are often situated urban contexts, where concepts of sustainability and (socio-technical) transitions are commonly considered in planning and sub-national decision-making processes (Voytenko et al. 2016). In addition, lab applications to foster systemic innovation are as well common in fields on other scales and contexts then the urban, including nature reserves and agricultural landscapes (e.g Westley et al. 2011). This applies for instance to lab-like applications originating from socio-ecological systems discourses, such as Transformation Labs (Olsson 2016) and adaptive management approaches (Folke et al. 2005, Olsson et al. 2004).

The relationship between labs in real-world contexts and the principles of transformation and integration can be understood in different ways. Firstly, they can be understood as a functional interrelation where labs are hosting and catalyzing processes and produce outcomes that can contribute to transformation and integration (Luederitz et al. 2017). Secondly, labs as research settings can, in principle, enable the observation and analysis of ongoing processes of transformation and integration, using experiments for instance to better understand chance processes (Schäpke et al. 2018b). Thirdly, labs themselves may come to existence as a result of the integration of actors and perspectives. All three relate back to a basic distinction between two perspectives in the analysis of societal change processes, namely the descriptive-analytical thinking about change dynamics often taking place at larger scales, and the prescriptive application of place-based governance to handle sustainability challenges (EEA, 2018). Labs are posed at the intersection of both, focusing on the place-based governance of sustainability challenges, but generating insights on dynamics on local and larger scales via processes of transfer and scaling. Both forms of interrelation do in turn ask for different forms of methods and procedures and, research-wise, do build on different epistemological forms.

Laboratories situated in the real world can be understood as settings that prompt the interrelation of both experimental and alternative practices in societal (proto-)niches, and mainstream, regime practices. Labs are constituted as experimental spaces, often at smaller scale levels and outside of the immediate influence of existing (mainstream) governance practices. At the same time, processes in labs are suggested to be related to ongoing mainstream activities – something that Wittmayer et al. (2014) describe as “being outside but not detached” from the regime. While the lab itself can be understood as a space for social learning based on experimentation and reflection, these learning processes go beyond the participants of the lab itself and transfer to other societal actors (Schäpke et al. 2017). In fact, experimentation will often be oriented towards influencing and potentially changing mainstream practices; it should be developed in a way that takes into account the functionalities and needs of current regime practices so that viable alternatives can be developed. Concrete processes that shed light on the interrelations between labs, their surrounding contexts, and their potential to transfer and scale (both within and across settings) are important in understanding the contribution of labs to transformation and integration. For example, such processes can occur can via social learning or networking. While the

situatedness outside of regular governance practices allows for experiments with radical and potentially transformative ideas to prosper, it is only when larger scale societal influences are achieved that these alternative ideas can actually transform systems.

This appeal towards transfer and scaling is not without critique. Caprotti and Cowley (2017) urge caution when arriving at the notion of experimentation in societal transitions, favoring an approach more cognizant of its spatial, political, normative and relational pretexts. Contemporary research from inside and outside of the transition community touch upon the spatial dimension of urban experiments (Coenen & Truffer, 2012; Raven, Schot, & Berkhout, 2012), the political implications of associated transitions (Meadowcroft, 2009; Raven et al. 2016; Shove & Walker, 2007) and critical dimensions of actor and perspective integration (Avelino, 2017; Avelino et al., 2017; Wittmayer et al. 2017; Rauschmayer, Bauler, & Schäpke, 2015). Thus, besides methods and procedures to foster transformation in labs, integration of perspectives and actors simultaneously plays a role.

If labs are conceptualized as spaces for experimentation, learning and interaction in the context of agenda 2030, this raises the question of how normative goals such as the SDGs can be approached in such labs. This is particularly relevant, as there are examples of existing lab approaches that explicitly relate to sustainability as a normative goal. A majority of existing lab approaches, i.e. living labs, do not often explicitly relate to sustainability; rather, they focus on innovation, efficiency increases or learning (Schäpke et al. 2018a). Accordingly, it is probable that some existing lab settings might contribute to aspects of transformation and integration, although that is not the core interest of the approach. At the same time it would be important to assess potential trade-offs and limitations of labs to actually contribute to transformation towards sustainability. For example, facilitated innovation may contribute to both transformation and sustainability – or foster economic growth via incremental innovation contributing to persistent unsustainability (Westley et al. 2011).

As a next step in fostering an understanding of labs in real world labs and their capacity to contribute to Agenda 2030, section 3 outlines the development and proposal an analytical framework for guidance. Distilled from highlighted principles transformation and integration, the intention of this framework is to facilitate a comprehensive enquiry into the breadth of existing lab approaches.

# 3 Proposing a broad analytical framework

The analytical framework outlined below is an attempt to operationalize *transformation* and *integration* into a set of subcategories and aspects. This preliminary version stems from the conceptual delineation (section 2) and is to be considered tentative. It seeks to open up for a dialogue on what some key analytical and normative elements of *transformation* and *integration* might be.

In parallel, also submitted to the IST-18 conference, is an attempt to allow these terms (referred to as keywords in this case) guide a cross-case analysis of two lab methodologies and their application in concrete cases in Canada and Sweden (Larsson, Williams & Holmberg, forthcoming)

In its current form, this framework identifies four broad categories: 1) Transformation - systemic change, 2) Transformation to sustainability, 3) Integration of perspectives, 4) Integration of actors.

## 3.1 Transformation

The elements of transformation were divided into the broad subcategories of "systemic change" and "to sustainability", each followed by a set of key aspects.

### *3.1.1 Transformation - systemic change*

**Object (system)**

Of central concern in systems transformations is the question of "what" system it is that actually transforms. Two prominent system delineations are those concerning socio-ecological and socio-technical systems. Socio-ecological systems are typically rooted in a spatial context and understood to consist of interlinked biophysical and social factors providing key services for groups dependent upon the system (Walker et al., 2004; Folke et al., 2005; Young et al., 2006). Socio-technical systems are conceptualized as a cluster of aligned elements such as technology, infrastructure, industry structures, markets, policy, legislation, knowledge, culture & norms oriented around the provision of societal functions such as energy, mobility and food services (Geels, 2002).

**Characteristics of the object (system)**

Socio-ecological systems are characterised by dynamic and complex behaviour, leading to concept development in this field around notions of adaptability, resilience, vulnerability (and transformability) (Walker et al., 2004; Young et al., 2006). Socio-technical systems are characterised by stability that is conditioned by path-dependencies, lock-in effects and inertia (Unruh, 2000; Geels, 2014). Both understandings can be considered to have characteristics of "complex adaptive systems" (e.g. Folke et al., 2005; Smith & Stirling, 2010; Andersson, 2014); being nested, open-ended, and having emergent properties.

**Quality of change (process)**

Socio-ecological transformations can be conceptualized as evolutionary cascades in e.g. ecological, economic and social structures, changing the *"whole panarchy with all its constituent adaptive cycles"* (Walker et al., 2004). This human-nature understanding of transformation can be defined as *"a fundamental change in a social-ecological system resulting in different controls over system properties, often mediated by changes in feed-backs that govern the state of the system"* (Chapin et al. 2012, p.3).

Fundamental changes in socio-technical systems happen on a level of consumption and production, termed "system innovations" or "transitions" (Geels; 2002, Elzen et al., 2004, Grin et al., 2010). Socio-technical systems are represented by differing levels of structuration, ranging from technological niches, to incumbent regimes and finally to broader socio-technical landscapes. Pressures can open up windows of opportunity for "transitions" in the existing systems. In transitions current trends break, moving the

system into new development trajectories, often described as a highly complex, open-ended, co-evolutionary, multi-actor and multi-faceted process (Markard et al., 2012).

Of relevance across both fundamental socio-ecological and socio-technical systems change are strategic reorientations in modes of transformative/double- and triple-loop learning amongst respective actors, organizations and institutions (e.g. Pahl-Wostl, 2009; Geels et al., 2016).

**Quality of change (outcome)**

Results of fundamentally changed systems are architectures different than those before, accompanied by potentially new aims and paradigms. The systems achieve new functionalities, qualities and unimagined possibilities. Actors, organizations and institutions experiences changes in e.g. identity, structures, practices and relations. In more recent developments in both socio-ecological (Folke et al. 2015) and socio-technical systems research (Loorbach et al. 2017), it is understood that these new systems may not only be radically different, but they will also reflect a more desired state (Rau et al 2018).

**Time dimension**

The time dimension of systems change is an aspect of concern. Present trends of "unsustainable" systems may move in the "wrong" direction or too slowly. Due to path-dependencies and lock-in effects the systems remain rather stable over time, but fundamental shifts can happen, often due to external shocks, breakthroughs or "tipping points". For instance, socio-technical transitions are typically reported to take place over periods of several decades (Markard and Truffer, 2012). Socio-technical systems are often analysed in their relation to niches and landscapes, where niches are understood as a protective space that enables development of alternative structures, and landscapes as the exogenous environment. Change processes in niches are said to unfold over periods of 0-10 years, regimes over decades and landscapes are considered "long durée movements", but rapid change can happen caused by disruptive events (Raven, Schot & Berkhout, 2012).

**How to govern**

Shared aspects in the governance of transformations and transitions are according to Loorbach et al. (2017) the issue of power, agency, discourse, visions, experimentation and learning. Transformations in socio-ecological systems are proposed to be adaptively governed, primarily during periods of crisis (Folke et al., 2005). In such governance, individuals, organizations, agencies, and institutions are connected at multiple levels, supporting the transformation of management organizations toward learning environments. It is said that transitions cannot be planned, predicted 'nor controlled, but influenced (Rotmans et al., 2001). To avoid lock-in effects and sub-optimization the idea is to frame short-term "disruptive" actions in a long-term perspective, e.g. through reflexive and 'transition' governance (Voss & Kemp, 2006; Loorbach, 2010).

**Where to change**

Governance of transitions (and transformations) are not one-off projects but an ongoing effort across multiple levels in society (Smith, Stirling and Berkhout, 2005). The art of governing systemic change is to make sense of complex systems, negotiating where one wants to go, building actor coalitions and

designing interventions. Here tensions can be identified in the gap present-future, in where acupuncture interventions can be made when windows of opportunity open. Preferably, such interventions are made in such way the efforts create platforms for further change in desirable directions (Holmberg & Robèrt, 2000).

**Why/for whom**

Traditionally**,** socio-ecological and socio-technical framings of fundamental change were descriptive-analytical in nature. Transformations and transitions were understood in more unconditional senses through emergent developments across a multitude of systems. The challenge outlined in Agenda 2030 however holds a far more active anthropocentric framing - the demand for human agents to purposely and intentionally influence future development of systems - i.e. to meet inter- and intragenerational human ends (this does not automatically mean situations will worsen for other plants and species). This implies that it is possible to influence transitions and transformations, rather than respond to them. This also reflected in the research developments in both approaches, as well as the in broad movement from "government" to "governance", and more recently to "good governance" in sustainability narratives (Bulkeley, 2013).

### *3.1.2 Transformation - to sustainability*

**Starting from desirable futures**

Agenda 2030 does not call for any kind of transformation, but a transformation into sustainability. This means that the process of change is to be guided by direction and purpose reflecting properties of "sustainability". It is here suggested that the future can provide a starting point of reflection of what kind of world we collectively want to live in, as what currently is and the problems in the present may hinder explorations of what could be and future opportunities (Senge, 1990; Stewart, 1993; Holmberg, 1998).

**All dimensions of sustainability**

One of the most prevalent understanding of sustainability over the last three decades stem from the Brundtland notion (WCED, 1987) of inter- and intragenerational justice with sustainable development as meeting present needs without compromising the ability for future generations to meet their needs. Generally, sustainable development is understood to encompass the three dimensions of the social, economic and environmental. Sometimes cultural and political sustainability are suggested as additional dimensions. Nevertheless, the concept of sustainable development and sustainability has a variety of different meanings (cf. Hopwood, Mellor and O'Brien (2005) for an overview). One can differ between strong and weak sustainability depending on how one is 'allowed' to substitute between capital (Solow, 1993, Daly, 1990). Vos (2007) differ between "thin" and "thick" versions of sustainability, contrasting conceptions on sustainability that are in discussion widely today, versus those requiring deeper transformations from today's dominating ideas.

**Wicked problem-solving vs creating the future**

Typically, proponents of sustainability argue for addressing root-causes addressing the "right problems", rather than reacting to symptoms. It has for instance been argued that regenerative sustainability

(Robinson & Cole, 2015) approaches are fruitful, moving beyond messages of sustainability being about scarcity, sacrifice, harm reduction and damage limitation. Instead, it argues that given the state of the world and the motivational aspects of positive visions, regenerative ambitions may inspire a source for transformative change. This is in close resemblance to Senge's (2003) distinction between modes of problem-solving vs. creating: *"in problem solving we seek to make something we do not like go away. In creating, we seek to make what we truly care about exist"* (p. 4).

**Sustainability as a process, substance and intent**

Across research fields sustainability is generally referred to as a process - driven by actions and steps towards a particular end; substance - translating knowledge into socially desirable change; and intent - the collectively juxtaposed understandings and visions amongst actors, institutions and governing bodies involved (cf. Robinson, 2004; Sneddon, Howarth & Norgaard, 2006; Waas et al., 2011).

**Levels and scales**

It is commonly acknowledged that sustainability is a global concept, Agenda 2030 refers to the SDGs as the "Global Goals", resting strongly on the idea of universality and linking the global with the local and the local with the global. It is generally recommended that any sustainability effort in a specific place demands reflection on its eventual implications elsewhere - at least across levels, scales and times.

**Resilience of the system**

Resilience is a term that can be related to sustainability. Traditionally, resilience referred to the mechanical capacity of an item to return to a previous state when tension is applied; whilst accurate in some extents, this paradigm fails to account for causality, the existence of external factors and a dynamic relationship between actor and agent (Becker, 2014). Having said that, one core ontological premise of resilience is regarding the presence of an equilibrium or "desired state" – whether perceived or desired. Resilience has been extended in socio-ecological systems discourse (cf. Holling, 1973; Folke et al., 2002).

## 3.2 Integration

Recently, it is common for society-science interactions to take place outside of academic settings. Within these digital or physical interaction spaces, stakeholders form diverse partnerships of companies, public agencies, universities, users, and other stakeholders, all collaborating in real-life contexts (Leminen, Westerlund and Nyström, 2012). Kates et al. (2002) claim that such ''participatory procedures involving scientists, stakeholders, advocates, active citizens, and users of knowledge are critically needed'' (p. 641). In an attempt to shed light on the these aspects, *integration* has been divided into two broad subcategories: 1) integration of perspectives and 2) integration of actors, each followed by a set of tentative aspects.

### *3.2.1 Integration of perspectives*

**Multi-dimension (time, space, and dimensions)**
Agenda 2030 brings forward the integration of economic, social and environmental dimensions as key to achieving sustainable development. It is generally emphasized that the dimensions' interconnectedness and mutual dependencies pose a key concern, challenge and opportunity in the realisation of sustainability (ESCAP, 2015). Furthermore, understanding and addressing sustainability challenges asks for iterative interrelations between both long term thinking (e.g. visions) and short term actions, as well as a global perspective and local and contextualized action. Labs so far have particularly been relate to localized approaches to sustainability. Some, such as urban transition labs (Nevens et al. 2013) and challenge labs (Larsson and Holmberg 2017), have included interrelations between short term action and long term visions and goals.

**Multi-knowledge**
Understanding and addressing the interrelations and interdependencies between different SDGs, as well as dimensions of sustainability touches upon knowledge from various different scientific disciplines. These include the basic dimensions of sustainability (economics and management, ecology, nature conservation, sociology and psychology). Many of these have as well developed specific sub-disciplines related to sustainability, such as sustainability management. Disciplinary integration focuses on interrelating knowledge on shared questions, problems or phenomena. Depending on the level of integration and co-production of knowledge, multi- or interdisciplinary approaches are pursued. Transdisciplinary approaches integrating knowledge from scientific and societal sources (e.g. tacit and indigenous knowledge) are proposed to enhance the social robustness, legitimacy and context-adequacy of insights developed (Lang et al. 2012, Kates et al. 2001). Labs in real world contexts frequently operate based on transdisciplinary collaboration, guiding integration of knowledge from scientific disciplines and societal actors. Forms and intensities of collaboration vary and serve different aims (Schäpke et al. 2018b).

**Multi-goal**
As a future-oriented approach aiming to foster transformation change in response to substantial real world challenges, labs will potentially impact various actors. This real-world orientation makes conflicts around lab processes particularly likely, demanding a win-win approach that allows those to interrelate and jointly pursue different agendas and interests simultaneously.

**Multi-group**
The integration of perspectives of various groups in society is proposed to meet demands of both inclusivity and representation. This includes perspectives across ages, genders, ethnicities, religions and origin, amongst other things. Perspectives of some groups do not necessarily carry a voice in current processes, such as future generations, nature and other species. Special attention is to be paid to such sidelined, marginalized perspectives (Loorbach et al., 2017) and the "no-voice" (Lewis, 2008); not necessarily for consensus building, but for producing decisions that are intergenerationally focused. Further, a diversity of perspectives in a group is often suggested to increase the level of creativity.

**Multi-method**

It is suggested that a variety of methods and a pluralistic approach can help in avoiding overly narrow prescription of solutions to sustainability challenges. Integration of knowledge from various scientific and societal sources on shared questions, problems and phenomena do ask for systematic, methodological approaches to generate comprehensive, coherent and consistent insights. This includes methods that focus on the process of knowledge integration from different sources. Examples include participatory scenario building, dialogue methods of participatory backcasting and envisioning. Other methods rather focus on interrelating inputs in a systematic and comprehensive fashion, such as integrated assessment modelling. Finally, methods exist focusing on the interaction of different aspects, such as systems thinking methods. Methods supporting processes of integration have been developed for many labs (e.g. for co-design and co-production in living labs). While several methods exist for specific integration forms, a pluralistic approach is often pursued (Fazey et al. 2018).

### *4.2.2 Integration of actors*

**Power**

Power remains a concept as frequently contested as it is conceptualized within and across various academic circles. With seminal developments in fields such as political theory and social theory, Avelino (2011) recently argues that overlapping points of discord can be categorized into five archetypes: 1) Power over vs power to; 2) Centered vs diffused; 3) Consensual vs conflictual; 4) Constraining vs enabling (structure vs agency); and 5) Power = knowledge vs power over knowledge. Moreover, power has been conceptualized importantly in debates concerned with the participation of different actors in decision making processes. As one of the most prominent contributions to participation and power, Arnstein (1969) developed a ladder progression to explore the "rungs" through which participation can be exercised. Varying from "manipulation" (lowest rung) to "active engagement" (highest rung), Arnstein regards participation as a reflection of power that is contested between citizens and power holders.

**Hierarchy**

Defined as "a conceptually or causally linked system of grouping objects or processes along an analytical scale" (Gibson, Ostrom & Ahn, 2000), hierarchy is situated at the meta-level of different perspectives. It has been interpreted in the context of socio-ecological transitions in relation to collective modes of collaboration and adaptive forms of governance as alternatives to traditional top-down governance (Folke et al. 2005). Within the transitions field, the multi-level perspective was initially interpreted as a hierarchical classification co-evolutionary processes between niche, regime and landscape levels (often referred to as a "nested hierarchy" - see Geels, 2011). However, when analyzing actor dynamics or exploring the way in which lab-related processes unfold in specific socio-spatial and political contexts, aspects of hierarchy and decision-making structures are now of interest in the governing transformative change.

**Control and Domination**

Partly connected to hierarchy, control and domination can be viewed as relational elements of interest, tied to decision making processes inside and outside of respective labs. At the level of the intervention,

Evans and Karvonen (2014) explore the notion of laboratization in the context of sustainability, claiming that labs attempt to embed the boundedness and controlled qualities of laboratories within a real-world setting that is messy and contingent. Within the space itself, actor dynamics reflect parallel tensions. Multiple roles, interests and values are exercised in a lab that operates at science-society fringe. Hence, control and domination relate to the decision-making powers that are both visibly and invisibly exercised within these settings, as well as the connection between lab processes and external decisions that might impact their potential for wider change. As an example, transition research suggests that labs, as bounded and protected niches, face a tension in staying true to their values in the face of socio-spatial dynamics within and outside of space (Wittmayer et al. 2017).

**Agency**

Agency refers to the dynamics and contributions between actors in the context of sustainability transitions. In a qualitative review process of the relationship between actors and agency in sustainability transitions, Fischer and Newig (2016) described agency as the implicit and explicit aspects of behaviour that relate to both collective and individual actors. Smith and Raven adopt an understanding of agency as " as the result of a collective and embedded capacity and hence developed and reproduced through actor networks" (2015,p.1031). In both cases, it is suggested that agency is historically underrepresented in theoretical contributions to transitions, and that more attention should be directed towards the socio-political and relational aspects of such change processes (Meadowcroft, 2009).

**Trust**

Trust has been identified as one element of interest in the experimentation of not only technological novelties, but also those associated with politics and governance. Coenen et al (2012) associate trust and culture with the development of partnerships that span multiple boundaries political or spatial boundaries. Likewise, the EEA (2018) highlight trust-based state functions as a means to foster enabling environments for transformative social innovation. This is in contrast to paternalistic modes of governance that favour bureaucracy and control. In a broader sense, trust can be extended as a prerequisite for organizing collective market-stake-society interactions (Wright, 2010), as well as networks such as transnational municipal climate networks (Busch, 2015).

**Diversity**

Diversity suggests not only who/what should be involved in purposive sustainability transitions, but how they should be considered and represented. Assuming a more normatively critical stance, diversity in this framework refers to 1) Non-human agency in transitions, 2) representation in participatory processes, 3) intergenerational mindsets and 4) worldviews and beliefs. Generally speaking, these notions tend to be under-represented in sustainability transitions debate yet are portrayed as central in the ambitions of Agenda 2030. In contrast to the MDGs, Agenda 2030 implies a widening of the realm of responsibility in the pursuit of a more sustainable future. In transition experiments, early attention is being drawn to agency of non-human actors (Caprotti and Cowley, 2017). Similarly, recent research on the value of ecosystem services as more than separate ecological entities; rather, they cultivate and enhance resource practices, and are significant sources of cultural exchange (Rau et al. forthcoming).

**Methods for actor integration**

As mentioned in section 2.1 above, integration of actors is not guaranteed by simply achieving a diversity of actors. Nor does it ensure that fundamental, or even realizable change will unfold as a result of the decisions made. Reed (2008) attributes this contradiction to the tensions and trade-offs between participation as a democratic right that enriches decision making processes and outcomes, and the connection of participatory practices to existing economic, political and environmental logics. Furthermore, and more relevant in the context of this study, Reed contends that "the quality of a decision is strongly dependent on the quality of the process that leads to it" (2008, p.2421).

In an attempt to overcome both caveats, albeit to different degrees, two strands of research which crosscut disciplinary practices are potentially relevant for methods of actor integration: 1) transdisciplinarity, and 2) user innovation, tightly tied to co-creation activities. Transdisciplinarity is defined as "a research approach that includes multiple scientific disciplines (interdisciplinarity) focusing on shared problems and the active input of practitioners from outside academia" (Brandt et al. 2013, p.1). Co-creation is often synonymous with participatory methodologies and user innovation processes, comprising "a continuous process of feedback and adaption between (some of) the users and the organizations involved in the Living Lab as the developers of the innovation" (Schuurman et al. 2015, p.7).

Table 1 below provides and overview of the broad and sub-aspects related to Transformation and integration. These analytic terms have been gathered in preparation for an ongoing review process. Section 4 will subsequently outline the methodological considerations underpinning this research.

| **Principles** | **Transformation** | | **Integration** | |
|---|---|---|---|---|
| **Categories** | Quality of change and system perspective | Broad and deep understanding of sustainability | Integration of perspectives | Integration of actors |
| **Sub-categories** | Object (system) | Starting from desirable futures | Multi-dimension (time, space, and dimensions) | Actor relations |
| | Characteristics of the object (system) | All dimensions of sustainability | Multi-knowledge | Power |
| | Quality of change (process) | Wicked problem-solving vs creating the future | | Hierarchy |
| | Quality of change (outcome-oriented) | Sustainability as a process, substance and intent | Multi-goal | Control |
| | Time dimension | | | Domination |
| | How to govern: | Levels and scales (local – global) | Multi-group | Agency |
| | Where to change | | | Trust/ Conflict Diversity |
| | Why/for whom | Resilience of the system | Multi-method | Methods for actor integration |

**Table 1**: Overview on analytical Framework for laboratories in real world contexts related to Agenda 2030

# 4 Methodology

This study will adopt a step-based systematic review approach. Systematic reviews enable the "identification, evaluation and interpretation of all available research relevant to a particular research question, or topic area, or phenomenon of interest" (Kitchenham, 2004, pg. 1). In this particular instance, the focus of this study will relate to the phenomenon of labs, situated in real world contexts. Figure 1 outlines the research design for the review process. This includes completed steps: 1) Framework development and 2) data gathering procedures, as well as the future steps: 3) data collection, 4) scoping and 5) mixed-method analysis.

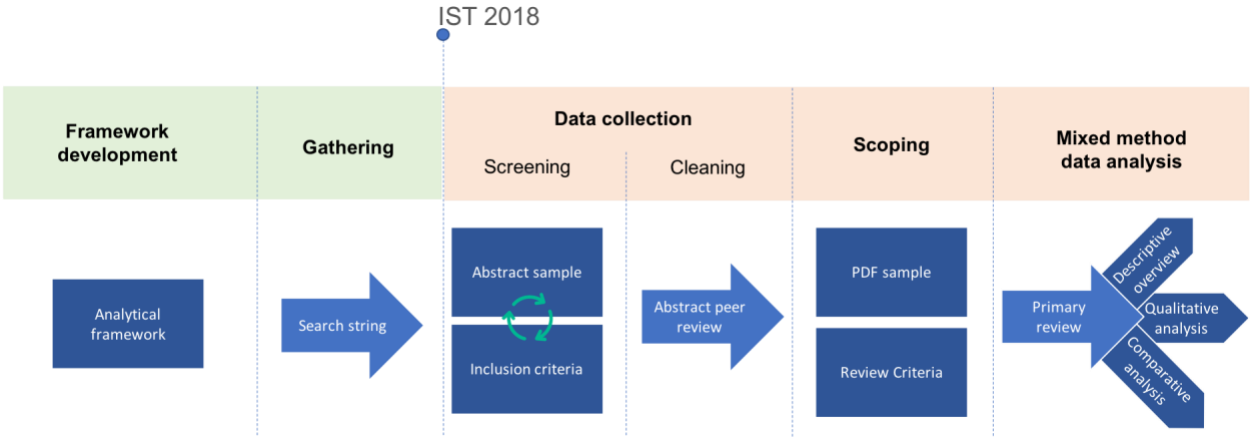


**Figure 1:** Methodology for review process: incorporating both current steps and expected next steps

Given that this paper outlines a research process that is currently on-going, the remainder of this chapter will motivate the steps completed to date (denoted in Figure 1, coloured green) as well as the expected review and analysis processes to be applied in the coming month until the end of 2018 (figure 1, denoted in orange).

## 4.1 Completed steps

### *4.1.1 Gathering*

This review is informed by the development of an analytical framework to discern elements of transformation and integration. This section will not expand on this framework; for more information, refer to chapter 2 for conceptual delineation, and chapter 3 for a description of the framework and overview table.

When developing a procedure for gathering data, we will rely on an earlier study (Schäpke et al. 2018a) and extend it in future steps. For the existing study (description taken from Schäpke et al. 2018a, supplement), we searched for publications on labs with relation to real-world context in the Scopus database. As many of the publications on respective lab approached include social science perspectives, we preferred Scopus over Web of science or other databases, as the former focuses more on social science literature. As for the database and the used search strings, we included only peer reviewed journal articles

and book chapters, and focused on publications in English language. Although this neglects non-peer reviewed publications, e.g. reports and discussion papers, and publications in other languages, we assume that the gained samples nevertheless provide a good overview on the respective scientific debates on LRW and RwL approaches.

The review included two searches; one for all types of laboratories in real-world contexts (1), a second focusing those laboratories in real-world contexts that topically relate explicitly to sustainability (2). We collected both as we assumed that as well laboratories that not explicitly focus on sustainability may reveal methods or procedures on realizing transformation and integration. The development of the search strings is outlined below and reproduced from Schäpke et al. (2018a, Supplement).

**Search-string 1**

We developed the presented search string, building on a prior, qualitative screening of relevant approaches (Schäpke et al. 2017). This screening did build on expert knowledge on the field as well as detection of further approaches of interest, supported via a snowball method from initially identified literature. Some terms and research areas were iteratively excluded to select only LRW publications relevant for our understanding of real world contexts. This included the exclusion of the search terms “transition experiment” and “real-world experiment” as they revealed a large number of predominantly natural science-based articles without relation to societal contexts. The analysis was limited to the mention of key terms (e.g. living labs) as part of the title, abstract of keywords of publications (N= 2193, 17.2.2018).

Search string: (TITLE-ABS-KEY ( ( "living lab*" OR "social lab" OR "social labs" OR "urban living lab*" OR "urban transition lab*" OR "transition arena*" OR "socio-technical experiment*" OR "campus living lab*" OR "campus lab*" OR "urban sustainability transition lab*" OR "innovation lab*" OR "transition lab*" OR "niche experiment" OR {design laboratory} OR "home lab*" OR "transformation lab*" OR "reallabor*" OR "real-world lab*" ) AND NOT "social labour" AND NOT "social labor" AND NOT "living labour" AND NOT "living labor" AND NOT "living label" AND NOT "labral" AND NOT "clinic*" AND NOT "animal* experiment*" AND NOT "label*" AND NOT "home labor" AND NOT "home labour" ) ) AND ( EXCLUDE ( SUBJAREA , "MEDI " ) OR EXCLUDE ( SUBJAREA , "PHAR " ) OR EXCLUDE ( SUBJAREA , "IMMU " ) OR EXCLUDE ( SUBJAREA , "NEUR " ) OR EXCLUDE ( SUBJAREA , "DENT " ) OR EXCLUDE ( SUBJAREA , "VETE "))

**Search-string 2**

In a second step, we searched for all publications with relation to sustainability within keywords, title and abstract. This second analysis of publications that include the term/ concept of sustainability revealed a lot smaller sample (N= 516, 17.2.2018).

Search string: ( TITLE-ABS-KEY ( ( "living lab*" OR "social lab" OR "social labs" OR "urban living lab*" OR "urban transition lab*" OR "transition arena*" OR "socio-technical experiment*" OR "campus living lab*" OR "campus lab*" OR "urban sustainability transition lab*" OR "innovation lab*" OR "transition lab*" OR "niche experiment" OR {design laboratory} OR "home lab*" OR "transformation lab*" OR "reallabor*" OR "real-world lab*" ) AND NOT "social labour" AND NOT "social labor" AND NOT "living labour" AND NOT

"living labor" AND NOT "living label" AND NOT "labral" AND NOT "clinic*" AND NOT "animal* experiment*" AND NOT "label*" ) ) AND (“Sustaina*”)

## 4.2 Future work: Data collection

In order to achieve a comprehensive and structured review, this study will incorporate data from multiple data source. This will include Web of Science as a supplementary database, as well as related white papers and case-based reports.

### *4.2.1 Screening and cleaning*

Inclusion criteria will be formulated in conjunction to the first stages of data collection. The aim of this approach is to enable the exclusion papers which might lie outside of the scope of this research (e.g. removing papers that relate to lab-based settings in biomedical science). Paper abstracts will then be assigned to reviewers in order to screen for relevance, as part of a peer review process. Relevance screening by more than one reviewer in systematic processes reduces the likelihood of individual bias in the research process (Sargeant & O’Connor, 2014). In the event that a reviewer is unable to include/exclude based on an abstract, a second reviewer will verify this abstract based on criteria. This is particularly important in data collection processes where multiple authors are involved (Kitchenham, 2004).

### *4.2.2 Scoping*

After papers have been screened and the overall sample has been cleaned, a number of papers will then be accepted for review. Following the collection of studies related to labs, PDF documents for the agreed literature pool will be downloaded from Scopus and Web of Science.

### *4.2.3 Analysis*

Following the collection and refinement of papers, this study will then apply the analytical framework as a lens to compare labs, with primary focus placed on capabilities appropriate for transformation and integration.

# 5 Preliminary overview of sample

The preliminary review revealed a substantial number of peer-reviewed articles and chapters, highlighting the salience of research in laboratories in real-world contexts in recent decades. This is evident in strongly increasing publication numbers (figure 2). While approaches “use different terms, build on different research traditions and are applied in multiple research contexts” they share some commonalities, such as “the collaboration of scientific and societal actors, their embeddedness in real-world contexts and use of experimentation” (Schäpke et al. 2018a: 8). Comparing labs in real-world contexts - generally those with an explicit relation to sustainability have increased the last ten years (Schäpke et al. 2018a). A topical relation to sustainability was given for some 36 percent of the overall LRW publications in 2017. Examples of sustainability related lab approaches include real-world laboratories, urban living labs, urban transition labs and sustainability living labs. Jointly, they may be considered part of a broader “experimental turn” in sustainability science (Overdevest et al. 2010).

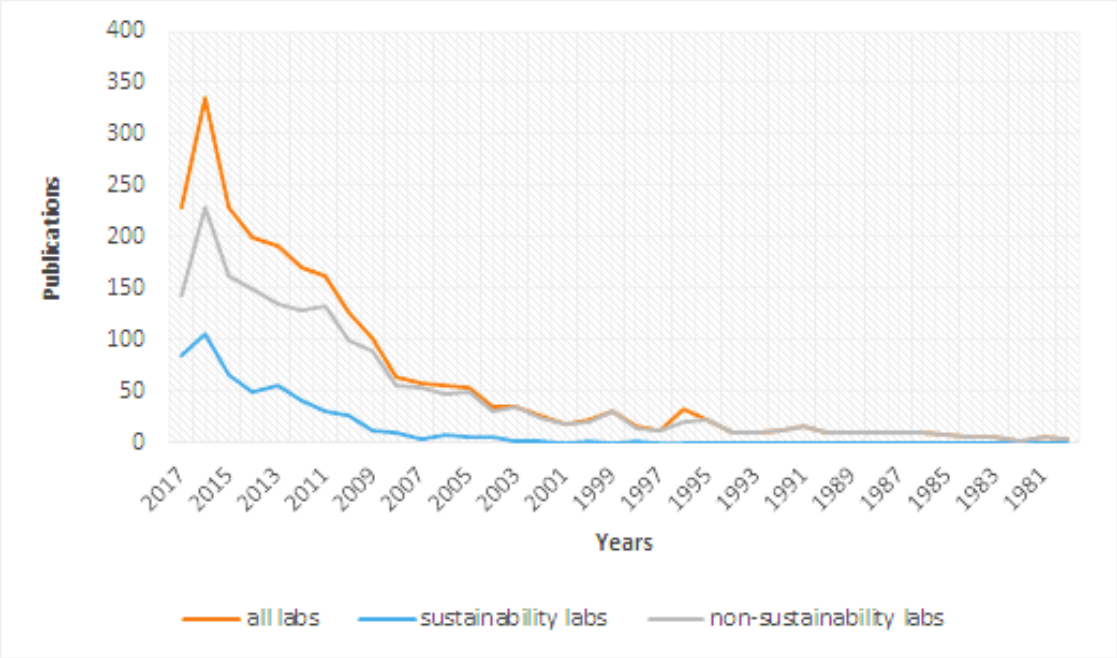


**Figure 2:** Number of annual publications on laboratories in real-world contexts (and with a topical relation to sustainability issues) in peer-reviewed journals and peer-reviewed books. Publications were identified via a title, keywords and abstract search in the Scopus database. (Taken from Schäpke et al. 2018a: 8, modified)

# 6 Conclusion and outlook

This paper presents a preliminary 1) conceptual delineation of transformation and integration, particularly in the context of Agenda 2030, 2) proposal of an analytical framework capable of conducting an enquiry on the suitability of labs in real world contexts to contribute to transformation and integration, and 3) description of the methodological approach and associated sample for data collection. Building on this, a systematic review process on the capacity of labs to contribute to integration and transformation will be carried out.

In line with the merits of review processes suggested by Kitchenham (2004), the following further contribution of the paper are expected to manifest. Firstly, the upcoming review will strengthen the connection between an emerging set of labs practices in real world contexts with the normative scope of Agenda 2030, an impact in its own right. Secondly, future results are expected to include a comparative mapping of the multitude of existing lab approaches, regarding their capacity of allowing for transformation and integration (see sub question 4, introduction). Relating these to the methods, processes and logics characterizing different lab approaches may thus enable the development of experimental arenas targeted relevant for Agenda 2030. Thus, contributions not only aim to enhance our understanding of labs as spaces of collaborative experimentation in general, but to implement labs as experimental modes of governance in pursuit of a sustainable future in particular.

Realizing ambitious sustainability goals in practice requires a willingness to enter into uncertain terrain. Laboratories provide an opportunity to navigate unknowns through modes of experimentation and learning-by-doing. Transformation and integration may provide key principles to ensure such laboratories contribute meaningfully and constructively to the urgent nature of Agenda 2030.

This paper invites feedback regarding all aspects of current status aund future development, including but not limited to: 1) theoretical premise, 2) methodological design, 3) structure and content of analytical framework.

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